Chapter 4

Environmental Consequences

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4. Environmental Consequences

This chapter describes the potential environmental impacts that may result from implementation of each of the considered alternatives described in Chapter 3. This chapter is the result of scientific, analytical, and qualitative comparisons of the three alternatives for future management of the Great Dismal Swamp NWR. The impacts are discussed for each resource in the order that they are presented in Chapter 2. By comparing the environmental consequences of all the alternatives, the USFWS can determine which alternative results in the best combination of beneficial impacts and the fewest adverse impacts.

Air Quality Impacts. *The primary impacts to air quality from refuge operations results from prescribed burning. Prescribed burning is implemented to restore historic fire frequency, improve habitat, and to reduce hazardous fuel accumulations. USFWS.*

Impacts are described in terms of severity (negligible, minor, moderate, and major), duration (short-term or long-term), and extent (local, refuge-wide, or regional). Impacts are not limited to the refuge property. While many impacts occur on a small, localized scale (i.e. erosion from soil disturbance), impacts are also discussed at a larger geographic scale (i.e., air quality impacts to Hampton Roads). Impacts may be either adverse or beneficial, or a combination of adverse and beneficial. A summary of criteria used for rating the severity of impacts is presented in Figure 4-1.

There are certain types of actions identified in Chapter 3 that do not require additional NEPA analysis because they do not individually, or cumulatively, have a significant effect on the human environment. These actions are "categorically excluded" from further analysis or review and, as such, their consequences are not further described in this chapter.

These categorically excluded actions include, but are not limited to, the following:

- Environmental education and interpretation programs - unless major construction is involved.
- Research, resource inventories, and other resource information collection activities.
- Operations and maintenance of existing infrastructure and facilities - unless major renovation is involved.
- Routine, recurring management activities and improvement
- Small construction projects (e.g. fences, berms, small water control structures, interpretative kiosks, development of access for routine management purposes).
- Vegetation plantings.
- Reintroduction of native plants and animals.
- Minor changes in amounts or types of public use.
- Issuance of new or revised management plans when only minor changes are planned.

Physcal Environment

Soils

A soil impact would be considered significant if it would result in one or more of the following:

- Occurrence of substantial erosion or siltation
- Occurrence of substantial land sliding
- Substantial damage to project structures/facilities
- Contamination of soils such that groundwater resources may be threatened

Alternative A

Impacts to soils would be adverse, minor, short-term, and localized. Impacts would result primarily from limited forest and fire management activities. These activities include commercial harvests of 1,000 acres of Atlantic white cedar, mechanical clearing of hardwoods to restore 2,000 acres of red-cockaded woodpecker (RCW) habitat in a pond pine/pocosin community, and establishment of fire breaks for prescribed burning. Since these activities would take place over organic soils, compaction and

Figure 4-1. *Criteria for Rating Severity of Impacts.*

Impact Severity:	Negligible	Minor	Moderate	Major
Short-term = Less than five years, normally during construction and recovery. **Long-term** = Longer than five years, normally from operations. **Cumulative** = Cumulative impacts to environmental resources result from incremental effects of proposed actions when combined with other past, present, and reasonably foreseeable future projects in the area.				
Soil Resources	Impact not perceptible and not measurable; not affecting surroundings.	Impact localized and slightly detectable but would not affect overall structure of any natural community.	Impact clearly detectable; could affect individual species, communities, or natural processes appreciably.	Impact highly noticeable and would substantially influence natural resources, e.g. individuals or groups of species, communities, or natural processes.
Water Quality	Impact not detectable, no discernible effect on water quality.	Impact slightly detectable but would not affect overall water quality.	Impact clearly detectable and could have an appreciable effect on the water quality of the environment.	Impact would have a substantial, highly noticeable, potentially permanent effect on the environment.
Air Quality	Impact not perceptible and not measurable; not affecting surroundings.	Impact perceptible but not measurable; would remain localized.	Impact detectable and possibly affecting integrity of surroundings. Air quality testing would be required.	Impact would have a significant impact on surroundings.
Aesthetics	Impact not perceptible and not measurable; not affecting surroundings.	Impact perceptible but not measurable; would remain localized.	Impact detectable and possibly affecting integrity of surroundings.	Impact would have a significant impact on surroundings.
Biological Resources	Impact localized and not detectable, or at lowest levels of detection.	Impact localized and slightly detectable but would not affect overall structure of any natural community.	Impact clearly detectable; could affect individual species, communities, or natural processes appreciably.	Impact highly noticeable and would substantially influence natural resources, e.g. individuals or groups of species, communities, or natural processes.
Threatened, Endangered, or Candidate Species	Change in a population or individuals of a species; consequences to population not measurable or perceptible, or other changes not measurable or perceptible.	Change in a population or individuals of a species, if measurable, would be small and localized, or other changes would be slight but detectable.	Change in a population or individuals of a species measurable but localized.	Change in a population or individuals of a species measurable and would result in permanent consequence to the population.

Figure 4-1.*Continued; Criteria for Rating Severity of Impacts.*

Impact Severity:	Negligible	Minor	Moderate	Major
Short-term = Less than five years, normally during construction and recovery. **Long-term** = Longer than five years, normally from operations. **Cumulative** = Cumulative impacts to environmental resources result from incremental effects of proposed actions when combined with other past, present, and reasonably foreseeable future projects in the area.				
Fire Regime	Impact not perceptible and not measurable; not affecting surroundings.	Impact mostly limited to consumption of surface litter, not significantly impacting vegetation.	Consumption of litter, duff, and live fuels; resulting in compositional changes in herb and shrub layers.	Compositional changes to canopy tree species; would result in development of fire-tolerant over-story.
Cultural Resources	Impact barely perceptible and not measurable; confined to small areas or affecting a single contributing element of a larger National Register District with low data potential.	Impact perceptible and measurable, but would remain localized; affecting a single contributing element of a larger National Register District with low to moderate data potential, or would not affect character-defining features of a National Register eligible or listed property.	Impact sufficient to change a character-defining feature but would not diminish resource's integrity enough to jeopardize its National Register eligibility, or it generally would involve a single or small group of contributing elements with moderate to high data potential.	Substantial, highly noticeable change in character-defining features would diminish resource's integrity so much that it would no longer be eligible for National Register listing, or it would involve a large group of contributing elements or individually significant properties with exceptional data potential.
Socio-economic Resources	Impact not detectable, no discernible effect on socioeconomic environment.	Impact slightly detectable but would not affect overall socioeconomic environment.	Impact clearly detectable and could have an appreciable effect on the socioeconomic environment.	Impact would have a substantial, highly noticeable, potentially permanent influence on socioeconomic environment.

creation of pools and hummocks would likely occur from movement of heavy equipment. The commercial harvests would likely have a greater impact than the restoration of RCW habitat because there would be multiple trips made over the soils to remove the harvested materials. RCW habitat restoration would involve only the removal of hardwoods and a fraction of the pine, therefore less equipment traffic would be required.

Both of the aforementioned forest management impacts would be expected to be of short-term duration. In the case of Atlantic white cedar harvest, the goal is to enhance regeneration of the Atlantic white cedar stand. With successful regeneration, no additional mechanical

manipulation of the stands would be expected to be needed for more than 100 years. Likewise, restoration of the RCW habitat would require this initial disturbance; however, except for prescribed fire activities, no additional mechanical disturbance would be expected. Negligible, long-term, adverse soil impacts would also be expected from the use of more than 50 miles of existing trails as bike routes and from the limited automobile access along existing trails leading to Lake Drummond. These trails would be established on a pre-existing network of access trails. To minimize impacts to existing access routes, automobile traffic is by permit only. The access route to Lake Drummond (Railroad/West/Interior Ditches) is maintained as an all-weather road, vehicle traffic on other routes is limited during wet conditions.

Alternative B

Habitat management activities involving mechanical clearing discussed in Alternative A would be greatly expanded under Alternative B. Commercial harvest of Atlantic white cedar would double to 2,000 acres and pine/pocosin habitat restoration would be increased to 10,000 acres. In addition, the Remnant Marsh would be expanded to 250 acres through mechanical clearing and prescribed fire. Soil impacts from each of these habitat management activities would be adverse, short-term, and minor.

The network of hiking and bicycling trails would be maintained at 50 miles under Alternative B and an automobile tour route would be established along Corapeake/Sherrill/Cross/Forest Line trails. Approximately 20 miles of trails would be paved to support more intensive vehicle use. The paved routes will reduce erosion from frequent vehicle travel. Eighty to 100 miles of roads would also be maintained to support fire suppression activities. Expansion of the bicycle trails would result in adverse, negligible, long-term, localized soil impacts. Pavement of routes to be used by automobiles would result in beneficial, minor, long-term, localized impacts by stabilizing soils.

Minor, adverse, short-term impacts to soils resources would also result from construction of trails to the habitat management areas for neotropical migratory birds and along Feeder Ditch, construction of an environmental education site at Jericho Lane, construction of wildlife observation towers at Feeder Ditch and at the intersection of Railroad and West Ditches, construction of a informational kiosk at the North Carolina Dismal Swamp Canal Welcome Center, and placement of interpretive panels along Railroad/West/Interior and Feeder Ditch.

More substantial soils disturbance would result from development activities. The impacts from facilities development would be localized, moderate, and adverse. These include development of two campsites for recreational vehicles (RVs) with electricity, water, and sewer facilities, construction of a facility on US Highway17 to serve as a visitor center and administrative headquarters for the refuge, establishment of an environmental education pavilion at Jericho Lane, and conversion of an existing building to house operations sub-headquarters and a visitor contact facility in Sunbury, North Carolina.

Alternative C

Impacts to soils would be less than under Alternative A or B because little forest management requiring the used of heavy equipment would be conducted. Forest management activities that would result in soils impacts would be limited to 2,000 acres of pine/pocosin restoration efforts for RCW habitat. The Atlantic white cedar harvests (in both Alternatives A and B) would not be conducted under Alternative C. Otherwise, forest access would be restricted to educational and/or research related access needs. Soil impacts from forest management activities would be adverse, minor, short-term, and localized.

Development of an outreach and education site would be similar to Alternative B, except the operations sub-headquarters/visitor contact facility in Sunbury, North Carolina would be eliminated. Of the three proposed alternatives, Alternative C would result in the least impact to soil resources. Soil impacts from facilities development would be adverse, moderate, short-term, and localized.

Water Quality

Significance criteria for water quality include:

- An adverse effect on water quality or an endangerment on public health by creating or worsening adverse health hazard conditions; or
- A violation of an established law or regulation that has been adopted to protect or manage water resources of an area.

The effects of water management activities would be similar under all three alternatives. Water management activities would be directed toward retarding channelized outflows and restoring hydrology to the swamp. These actions would increase groundwater infiltration and improve water quality. While water control structures would reduce the drainage effect of ditches, water levels would be monitored to reduce the threat of inundation and erosion of refuge roads.

Alternative A

Impacts to water quality under Alternative A would result from sedimentation from harvesting and mechanical clearing activities, and from sedimentation from biking/hiking trails and automobile access routes.

Adverse, negligible, short-term impacts would result from sedimentation during harvesting and mechanical clearing activities. Adverse impacts would be negligible and long-term from erosion of dirt paths used as

biking/hiking trails and automobile access routes.

Alternative B

Impacts to water quality would be minor and generally short-term. Some negligible long-term impacts would result from runoff of vehicle fluids from paved surfaces and emissions from outboard motor use in Lake Drummond. Water quality impacts would be greatest under Alternative B. Impacts from forest management activities would increase over Alternative A levels only because of the increased acreage being treated.

More notable water quality impacts would result from construction of new facilities, primarily the new refuge administrative headquarters and visitor center on US Highway 17. Other facilities would have negligible water quality impacts because the environmental education pavilion at Jericho Lane would have no sanitary facilities or would use self-contained chemical facilities, and the new sub-headquarters/visitor contact facility in Sunbury, North Carolina would be adapted from an existing structure. Construction impacts should be both temporary and minor, being minimized by proper erosion and sediment control measures. Long-term, localized, adverse impacts may result from sanitary wastes and from runoff from parking areas. These impacts can be minimized through proper waste handling facilities and the use of a stormwater catchment basin for parking areas. Development of campsites for volunteers would be located at the Sunbury facility and existing sanitary facilities would be used.

Potentially the most widespread water quality impacts would result from the pavement of approximately 20 miles of access trails. Paved areas would be installed at Jericho Lane (1.0 miles) and Washington Ditch (2.0 miles) from White Marsh Road to the second gate. The primary access route to Lake Drummond (the Railroad/West/Interior Ditch corridor) would be paved (approximately 6.2 miles). Lastly, the automobile tour route along Corapeake/Sherrill/Cross/Forest Line Ditches would be paved along its 12.5 mile length.

The impacts from paving result from runoff of car fluids (antifreeze, oil, etc.) directly into the ditches. Porous surfaces, such as the current dirt path, provide infiltration into the soil where adsorption sites allow contaminants to be held and decomposed before entering the water or groundwater system. These impacts would be expected to be negligible.

Alternative C

Impacts to water quality would be minor because water quality impacts from forest management activities would be less than Alternatives A and B. Forest harvests and mechanical clearing would only be conducted on 2,000 acres of pond pine/pocosin habitat.

Water quality impacts from facilities development would be similar to Alternative B, except that the Sunbury, North Carolina facility would be eliminated.

Hydrology

Hydrologic impacts would be considered significant if they resulted in:

- A threat or damage to unique hydrological characteristics;
- Altered water availability, quality, or use;
- A reduction in water availability to existing users or interfere with the supply; or
- A creation or contribution to overdraft of groundwater basins or exceeding a safe annual yield of water supply sources.

Perhaps the greatest man-made disturbance in the Great Dismal Swamp NWR is alteration of the natural hydrology. This disturbance results from centuries of efforts to drain the swamp to improve access to timber resources and to improve agricultural productivity. In addition to the direct impact that the ditches have on surface waters, the Dismal Swamp Canal and other ditches were cut to such a depth as to intercept the shallow aquifer allowing ground water to upwell to the surface during droughts.

In addition to the impact of ditches, hydrologic impacts result from the creation of barriers to surface water flow. This is evident in the northern portion of the refuge where the Norfolk and Southern Railroad tracks have prevented drainage and created abnormally wet areas and in the south where US Highway 158 prevents drainage, but also exists throughout the refuge where spoil piles adjacent to ditches prevent mass surface flows.

Alternative A

Impacts to hydrology would be beneficial and minor because Alternative A would result in slight improvement of hydrologic conditions at Great Dismal Swamp NWR. Using existing water control capabilities, water levels would be conserved to restore hydrologic conditions in habitats where cypress, gum, and maple dominate and to maintain groundwater levels within one foot of the ground surface in Atlantic white cedar stands. Water levels would be managed to prevent flooding of refuge roads and to limit surface flooding where these conditions may interfere with ground-foraging neotropical migratory birds.

The refuge would cooperate with landowners to ensure that refuge operations do not result in unwanted flooding of adjacent private property and coordinate with landowners along the Pasquotank River regarding operation and maintenance of the Newland flood control dike

Alternative B

Alternative B would result in improvements to the current hydrology of the refuge. In addition to impacts under Alternative A, hydrologic conditions under Alternative B would be further improved by installation of water control structures along Portsmouth Ditch and East Ditch, and by development of a GIS-based surface flooding models to assess management strategies. Under Alternative B, the refuge would also cooperate and support protection of approximately 15,000 acres of seasonally-flooded forests south of US Highway 158 and efforts to restore surface hydrology.

Under Alternative B, the refuge would also support efforts to restore natural surface flow where off-refuge developments have impeded drainage creating abnormally wet conditions. These combined effects would yield major, long-term, beneficial impacts that would impact areas beyond the refuge boundary.

Alternative C

Impacts to hydrology would be minor and beneficial because they would be the same as those described under Alternative A.

Air Quality

Air quality impacts would be significant if:

- Pollutant emissions associated with the proposed action caused, or contributed to a violation of any national, state, or local ambient air quality standard, exposed sensitive receptors to substantially increased pollutant concentrations, represented an increase of ten percent or more in affected Air Quality Control Region's (AQCR) emissions inventory, or exceeded any significance criteria established by the Virginia State Implementation Plan (SIP).
- In nonattainment areas, the net change in proposed pollutant emissions caused or contributed to a violation of any national, state, or local ambient air quality standard; increased the frequency or severity of a violation of any ambient air quality standard; or delayed the attainment of any standard or other milestone contained in the Virginia SIP.

The primary impacts to air quality from refuge operations results from prescribed burning. Prescribed burning is implemented to restore historic fire frequency, improve habitat, and to reduce hazardous fuel accumulations. The application of prescribed fire is expected to produce long-term benefits; however some short-term negative impacts may result.

Alternative A

Air quality impacts under Alternative A result from heavy equipment emissions and prescribed burns. Localized, minor, adverse, short-term impacts would result from heavy equipment emissions during harvesting and mechanical clearing. Prescribed fire impacts to air quality would be short-term and minor in magnitude because burning would be conducted under conditions that would support rapid dispersion of smoke and while wind directions transported smoke away from heavily populated areas. Prescribed fire directly impacts air quality in three principal ways: decreased visibility, increased particulates, and increased pollutants. Prescribed burning would be used following harvest to remove debris over 1,000 acres of Atlantic white cedar community. A long-term prescribed fire plan would also be implemented to help restore and maintain pond pine/pocosin community to support restoration of red-cockaded woodpecker habitat.

Alternative B

Impacts to air quality under Alternative B would be adverse, minor, and short-term. Impacts are similar to those described under Alternative A, though they apply to a larger area. Air quality impacts resulting from the implementation of Alternative B would be similar to those discussed for Alternative A. Increased (but still minor) adverse impacts would result from increases in harvesting (1,000 acres to 2,000 acres), mechanical clearing (2,000 acres to 10,000 acres), and prescribed fire (an additional 8,000 acres).

Negligible, short-term, adverse air quality impacts would result from the release of volatile organic carbons from the asphalt paving applied to trails that would receive increased vehicle use and from heavy equipment emissions during construction of new facilities. Additional negligible, long-term, adverse impacts would result from increased vehicle emissions from the opening of an automobile tour route and from interpretive tours.

Alternative C

Under Alternative C, impacts to air quality from heavy equipment emissions and prescribed burns would be adverse, minor, and short-term. Impacts from increased vehicle emissions from the opening of an automobile tour route and from interpretive tours would be adverse, negligible, and long-term.

Contaminants/Hazardous Materials

None of the alternatives would likely result in significant impacts to contaminants or hazardous materials at Great Dismal Swamp NWR. Contaminants that have been identified do not occur at high levels.

Aesthetics

Alternative A

Impacts to aesthetics would be moderate, adverse, and short-term; however, they would be limited to a remote section of the refuge. Aesthetic impacts would result from the harvest of 1,000 acres of Atlantic white cedar. The impact results from the visibility of heavy equipment operations and from the loss of solitude resulting from the noise of harvest operations and the frequent travel of log trucks along vehicle corridors.

The helicopter operations to salvage Atlantic white cedar stands will create temporary impacts to aesthetics in remote sections of the refuge. However, the aesthetics of these areas were already altered by the hurricane, and the helicopter operations should be completed by 2006.

Alternative B

Impacts to aesthetics would be moderate and a combination of short-term and long-term impacts. Short-term aesthetic impacts would result from forest management activities associated with habitat restoration. Visual appeal would be impaired from Atlantic white cedar clearcuts totaling 2,000 acres (approximately 100-200 acres each spread over a 15 year period). Hardwood harvesting in the 10,000 acre red-cockaded woodpecker habitat restoration area would result in only negligible impacts since most of the pine canopy would be retained. Aesthetic quality would also be diminished by the noise generated by heavy equipment during these operations.

Visually, the construction of an observation tower overlooking Lake Drummond at Feeder Ditch would have mixed impacts. While the observation tower would have beneficial impacts by expanding viewing opportunities, it would have adverse impacts to the view of the natural shoreline as seen by boaters. The implementation of a canoe/kayak rental would have minor positive impacts by allowing visitors to experience the solitude of the lake. Adverse visual impacts would also result from the paving of access routes. For some visitors who seek a natural area or to see wildlife in there natural setting, paved roads are a symbol of development.

Alternative C

Impacts to aesthetics would be adverse, minor, and long-term. Under Alternative C, forest management impacts would be limited to restoration of 2,000 acres of red-cockaded woodpecker habitat, a negligible short-term impact. Aesthetic impacts around Lake Drummond would be identical to those described in Alternative B and

would result in mixed long-term impacts.

Biological Resources

An impact to the natural biological resources would be considered significant if the actions would:

- Affect a threatened or endangered species;
- Substantially diminish habitat for a plant or animal species;
- Substantially diminish a regionally or locally important plant or animal species;
- Interfere substantially with wildlife movement or reproductive behavior;
- Result in a substantial infusion of exotic plant or animal species.

Fauna

Alternative A

Impact to white-tailed deer populations would be negligible, adverse, and long-term. White-tailed deer are abundant throughout the region and the annual hunt conducted by the refuge is consistent with deer management within Virginia.

The refuge deer hunt is conducted during October-November, so the hunt will not impact the bald eagle nesting that occurs during March-April. The areas in which white-tailed deer hunts are conducted include the potential habitat for red-cockaded woodpeckers, but no woodpeckers are known to exist within the area at this time. Collaboration and consultation with woodpecker recovery specialists to assess potential impacts of the deer hunt will occur upon introduction or discovery of red-cockaded woodpeckers on the refuge.

The habitat protections in Alternative A and C are less aggressive than those proposed in Alternative B. Under Alternative A, the refuge would continue to collaborate with local governments and provide technical assistance regarding development within the historic range of the Great Dismal Swamp and areas adjacent to the refuge. The refuge would also partner with The Nature Conservancy and state wildlife agencies to protect and restore seasonally-flooded areas within the refuge watershed.

Waterfowl would receive minor benefits from managing public access to

Lake Drummond to limit disturbance of overwintering tundra swans and snow geese.

Alternative B

Alternative B would provide major, long-term impacts that would be beneficial to fauna. Impacts would be similar to those discussed under Alternative A. The greatest benefit to fauna is achieved under Alternative B, which includes the greatest amount of habitat restoration, including restoring 10,000 acres of pond pine/pocosin community and restoration of 250 acres of remnant marsh, cooperation in the development of 7,000 acres of prior-converted farmland east of the refuge, and cooperation in the protection of 15,000 acres of seasonally-flooded forests south of US Highway 158. Minor benefits are derived simply from the expansion of available habitat. Major benefits would be expected from the widespread use of prescribed fire. Several studies have shown the benefits to fauna from the use of prescribed fire, including increased species richness and diversity of small mammals and birds (USFWS, 2003, p. 106).

Implementing a limited recreational bear hunt in Virginia would result in negligible adverse, short-term impacts to the black bear population. These impacts would consist of disruption of daily activities such as foraging and resting during the bear hunt. However, these impacts maybe offset by the anticipated benefits to bear habitat of the above mentioned habitat improvements.

An in-depth evaluation of the potential long-term impacts of the bear hunt was conducted. Two studies completed on the bear population within the Great Dismal Swamp, almost 20 years apart, have shown little change in the population density (Hellgren 1988 and Tredick 2005) which indicates a stable population of bears.

The initial harvest recommendation was set based upon consultation with the Virginia Department of Game and Inland Fisheries, the North Carolina Wildlife Resources Commission, and Dr. Michael Vaughan of Virginia Polytechnic Institute and State University (VPI&SU),(the professor involved with both of the above-cited bear studies).

A harvest target of 20 bears for the hunt was based on the conclusion of the researchers that a hunt would not have an adverse impact on the bear population if no more than 20% of the female bears were taken. Both of the above cited studies assume a population of 250-350 bears. A 50:50 male:female sex ratio is generally assumed. Twenty percent of the female bear population would then be 25-35 bears. This hunt proposes a cap of 20.

Additionally, the maximum number of hunters was determined by examining hunter success rates. Nearby states have hunter success rates of up to 5.5% on bear hunts. This rate included hunts with dogs and hunts on previously un-hunted populations as well as hunts on denser populations (2004-2005 Maryland DNR Black Bear Report). If

100 hunters each day are allowed to hunt, using a 5.5% hunter success rate, an approximate take of 11 bears is anticipated.

An additional evaluation of the 2005 study by Catherine Tredick concerning the potential of the hunt creating an isolated population was conducted. Tredick's study states that "Genetic statistics at GDSNWR indicate that this population is isolated to some degree by geography (i.e., the Albemarle Sound) and encroaching urban development (i.e., the towns of Suffolk and Chesapeake) (Tredick 2005, i). Further discussion with both Tredick and Vaughan clarified that the Great Dismal Swamp population is isolated from the other two populations studied on the other side of the Albemarle Sound (Alligator River NWR and Pocosin Lakes NWR). Additionally they agreed that the hunt would not be detrimental to the bear population when held within the described parameters (personal communication, 26 October 2005, Columbia, NC).

Finally, no federal endangered or threatened species would be impacted by the proposed bear hunt. Nor would there be any major impacts to state listed species. Based upon this review of the proposed bear hunt, impacts to the Great Dismal Swamp NWR bear population would be minimal.

The impacts to white-tailed deer would be the same as Alternative A. The refuge deer and bear hunts will be conducted during October-December, so the hunts will not impact the bald eagle nesting that occurs during January -April. The black bear hunts will not be conducted within the area designated for habitat enhancement for the endangered red-cockaded woodpeckers. The white-tailed deer hunt area includes the potential habitat for red-cockaded woodpeckers, but no woodpeckers are known to exist within the area at this time. Collaboration and consultation with woodpecker recovery specialists to assess potential impacts of the deer hunt will occur upon introduction or discovery of red-cockaded woodpeckers on the refuge.

Alternative B would allow lethal control of beaver and nutria when their activities result in habitat damage or interfere with the operation of water control structures. This is a negligible, adverse, short term impact on the beaver population.

Alternative B would allow lethal control of nutria – an invasive, exotic, destructive species.

Waterfowl would benefit from disturbance management (as noted in Alternative A) and from coordination to protect adjacent farmlands that are used by waterfowl.

Alternative C

Alternative C, the Limited Habitat Management alternative, would still provide minor beneficial impacts to fauna. Benefits to a range of fauna would result from the restoration of 2,000 acres of pond pine/pocosin habitat. White-tailed deer impacts would be the same as Alternatives A

and B. Benefits to birds would be similar to Alternative A.

Flora

Alternative A

Alternative A would provide moderate, long-term beneficial impacts on the vegetation communities within the Great Dismal Swamp NWR. Efforts to regenerate Atlantic white cedar would be expected to provide immediate benefits to this rare community type and would also provide valuable information regarding the future management of the remaining Atlantic white cedar stands. (GDSNWR AWC represents 10% of known AWC remaining globally). The pond pine/pocosin habitat, another rare community type, would also benefit from management actions proposed in Alternative A. Alternative A would clear hardwoods and restore fire to its historical frequency in this community that is suffering from fire suppression throughout its range. Removal of hardwoods and restoration of fire would provide long-term stability by preventing hazardous accumulations of peat and mid-story fuels, while promoting the regeneration of pond pine. The remnant marsh would be maintained at its present 30 acres through the use fire and would be monitored to assess habitat maintenance techniques.

Water management practices would restore natural hydrologic conditions to habitats dominated by cypress, gum, and maple providing minor, beneficial impacts; and would support efforts to restore hydrology to areas affected by off-refuge development and encroachment (i.e. US Highway 158 and Norfolk-Southern Railroad).

Alternative B

Moderate, beneficial, long-term benefits would result from the implementation of Alternative B. Alternative B would provide the greatest benefits to the vegetation of the Great Dismal Swamp NWR. Expanded efforts to regenerate Atlantic white cedar would affect twice the area (expanded to 2,000 acres) and restoration efforts in pond pine/pocosin would affect five times the area (expanded to 10,000 acres) proposed in Alternative A. The remnant marsh area would be expanded to 250 acres, a sizeable expansion over the 30 acres that is currently being maintained. Additionally, 5-10 acres patch openings would be created to establish foraging areas for neotropical migratory birds.

Minor, localized, negative impacts to vegetation would occur within the footprint of paths and structures created for education, observation, and outreach. The small amount of vegetation lost to these developments is very minor compared to the benefits of thousands of acres of habitat restoration planned.

Alternative C

Minor, long-term, beneficial impacts to flora would result from implementation of Alternative C. Alternative C would provide the fewest

benefits to vegetation on the refuge. The core pond pine/pocosin area designated for restoration of red-cockaded woodpecker habitat would still receive mechanical treatment and prescribed burning. Water would also be retained to restore hydrology to area dominated by cypress, gum, and maple. These would be the few management activities included under Alternative C, the "Limited Habitat Management" alternative. Minor negative impacts would still result from development associated with expanded education and outreach opportunities, but these impacts would be less than Alternative B.

Rare Species

Alternative A

A major, long-term, beneficial impact would result from creation of a new population of federally-endangered red-cockaded woodpeckers supported by habitat restoration efforts to assure long-term viability. Alternative A would result in habitat enhancements to benefit the restoration of breeding red-cockaded woodpeckers on the refuge. Restoration efforts would include the removal of hardwood and restoration of fire to 2,000 acres of pond pine/pocosin habitat. This would provide core habitat needed to support a sustainable population of reintroduced endangered red-cockaded woodpeckers. Source woodpeckers would be provided from individuals displaced under Safe Harbor agreements. Additional improvements would result from the management of water levels to enhance habitat for neotropical migratory birds.

Alternative B

Major, long-term, beneficial impacts would result from creation of a new population of federally-endangered red-cockaded woodpeckers supported by habitat restoration efforts to assure long-term viability. Alternative B would provide the greatest benefits to rare species. The primary positive effect would result from the removal of hardwood and restoration of fire to 10,000 acres of pond pine/pocosin habitat. This would initially provide core habitat for the reintroduction of endangered red-cockaded woodpeckers. Source woodpeckers would be provided from individuals displaced under Safe Harbor agreements.

Additional benefits to rare species would be achieved by the establishment of clearings to provide foraging habitat for neotropical migratory birds. If managed properly, these clearings would provide habitat for neotropical migrants such as Swainson's warbler.

Increased activity levels on Interior Ditch include paving and increased traffic from Lake Drummond access for tours and canoe/kayak rentals. Since Interior Ditch is more than 1,320 feet north of the active bald eagle nest, these activities would not be expected to have adverse impacts.

Alternative C

Alternative C would also result in major, long-term, beneficial impacts to rare species, though benefits would be limited to the creation of the minimum habitat area needed to support a viable red-cockaded woodpecker colony.

Fire Regime

Alterations of fire and hydrology are the most immediate threats to the range of habitats present at Great Dismal Swamp NWR. While efforts have already been undertaken (and continue) to restore the natural hydrology of the swamp, the restoration of fire has proven to be much more challenging. The hesitancy to fully return fire to the refuge has many roots, including risks to public health, concerns about damaging a valuable resource, and the ability to control the fire within prescribed boundaries.

The refuge landscape is not static. The frequency and extent of fire 4,000 years ago when much of the swamp was grassland would not be appropriate to habitats present today. However, fire was an important component in the evolution of the swamp we see today. For example, it is widely thought the Lake Drummond, the central feature of the refuge, may have been formed by a deep burning peat fire. The swamp is a matrix of habitats that are created by disturbance and are in various states of recovery: from frequent fires that maintain canebrake or pocosin to infrequent but catastrophic fires that regenerate the Atlantic white cedar stands. Many questions remain to be answered as fire management is integrated with habitat restoration on the refuge. At what level should fire be returned to the refuge? Should fires be suppressed aggressively or allowed to burn to mimic past fire regimes and disturbances? Ultimately, the answers to these questions will be a balance of habitat requirements and social tolerance of the products of fire, mainly smoke and decreased visibility.

Alternative A

Impacts to the fire regime under Alternative A would be major, beneficial, and long-term. Wildfire would be managed in accordance with the 1998 Fire Management Plan. Prescribed fire use would be expanded to manage for red-cockaded woodpecker habitat, Atlantic white cedar regeneration, and maintenance of the remnant marsh.

Alternative B

Implementation of Alternative B would result in major, long-term benefits. Alternative B represents the greatest effort toward restoring fire to habitats where its exclusion threatens their community composition. Prescribed fire use would be expanded under Alternative

B to maintain more than 10,000 acres, including pond pine/pocosin and remnant marsh. Prescribed fire would also be used to more aggressively manage hazardous accumulations of fuels in wildland/urban interface settings and to remove woody debris following AWC harvests. Wildfire suppression capabilities would be enhanced by acquiring easements to improve emergency access and maintaining 80-100 miles of access trails.

Alternative C

Impacts to the fire regime under Alternative C would be the same as Alternative A, major and long-term.

Cultural Resources

Archeological and Historic Resources

Human occupation of the Great Dismal Swamp area dates back some 13,000 years, 4,000 years before the formation of the swamp began. Four cultural periods -- Paleo-Indian, Archaic, Woodland, and Historic -- represent a continuum of human inhabitation. Much of the known evidence has been collected on upland sites along the western margin of the refuge. It is likely that other sites exist within the refuge, but have been covered by the accretion of organic soils during formation of the swamp that is present today.

None of the proposed alternatives would significantly affect cultural resources. Impacts would be limited to the very small footprint of proposed buildings and kiosks, and from the construction of fire lines. No activities are proposed on any known culturally-significant sites and appropriate cultural resource investigations would be conducted prior to any ground disturbing activities to ensure protection of undocumented cultural resources.

The proposed alternatives will not likely negatively impact cultural resources at the Great Dismal Swamp NWR, nor will they provide positive impacts through identification of significant cultural resource areas.

Socio-Economics

Staffing and Budgets

Alternative A

Alternative A would result in minor, long-term, beneficial impacts. Under Alternative A, the Great Dismal Swamp NWR would maintain a staff of 19 persons (Appendix D). The staff salary budget would contribute $1,051,478 annually to the local economy. In addition, maintenance, development, and projects identified in Alternative A involve approximately $7 million during the life of this document (Appendix H).

Additional short-term economic benefits would result from employment during timber harvests associated with restoration and habitat regeneration efforts.

Alternative B

Under Alternative B, moderate, long-term, beneficial impacts would result from increased staff at GDSNWR above Alternative A levels. Staffing at Great Dismal Swamp NWR would increase to 27 people. The staff salary budget for Alternative B would be $1,619,722 annually. Additional projects identified in Alternative B would result in approximately $41 million in spending during the 15-year life of this document. The additional refuge positions are equally divided between habitat management positions and education/outreach positions.

Additional short-term economic benefits would result from employment during timber harvests associated with restoration and habitat regeneration efforts.

Alternative C

Alternative C would provide 23 staff positions at GDSNWR (an intermediate staffing level between Alternatives A and B). The primary focus of the positions would be education and outreach. Annual staff salary budget for Alterative C would be $1,382,858; additional expenditures of approximately $38 million would be needed to fulfill the goals of Alternative C. This would result in moderate, long-term, beneficial impacts.

Additional short-term economic benefits would result from employment during timber harvests associated with habitat restoration.

Public Use (Education, Recreation, Hunting, Tourism)

Public use of the Great Dismal Swamp NWR includes tourism, recreation, hunting, fishing, boating, and wildlife observation. Economic impacts result from purchases such as lodging, meals, gasoline, shopping, transportation, and admission and license fees. The *1997-1998 Virginia Visitor Survey* sampled visitors to assess many criteria. When the study examined spending from both day-use and overnight visitors, mean expenditures per person per day totaled $52 (Virginia Tourism Corporation 2000). The 2000 Virginia Outdoors Survey indicated that visitors to Virginia state parks spend approximately $16 day (90 percent of visitors are day-use). When overnight visitor use was examined, expenditures averaged $54-58 per person per day – a value consistent with the *1997-1998 Virginia Visitor Survey* findings. As an estimate of the economic impact of visitor use at the Great Dismal Swamp NWR, predicted visitor-days is multiplied by the visitor expenditures determined from Virginia state park visitors during the 2000 Virginia Outdoors Survey ($16/day). This value is used because, like state park visitors, most visitors to the Great Dismal Swamp NWR are day visitors.

Many visitors have multiple visitation objectives including recreation (beaches and theme parks), historic sites (battlefields, Colonial Williamsburg), education and cultural sites (museums), hunting and fishing, and ecotourism. The Great Dismal Swamp NWR is a valuable component of the variety of available opportunities that attracts visitors to the Hampton Roads region.

Alternative A

Under Alternative A, the Great Dismal Swamp NWR would provide negligible benefits to educational opportunities. The benefits would include classroom programs at local schools and libraries, partnerships for teacher training, loaning field equipment to students, developing educational videos, and being available as an outdoor classroom.

Other minor, beneficial public use impacts under Alternative A would result from opportunities for hunting, fishing, and scenic and wildlife observation and photography. A hunting opportunity would include a limited deer hunt in October/November. For fishing, Lake Drummond would be accessible year round during daylight hours via the Feeder

Ditch. Boats may be transported by vehicle to the lake by permit only during the period from April 1 through June 15.

Public access for wildlife observation, hiking, and biking is available via three corridors (Jericho Ditch Trail, Washington Ditch Trail, and the Railroad/West/Interior Ditch).

Total visitor use of 75,000-80,000 visitor-days would be expected. The expected economic impact from this tourism and recreational use would be $1.2-1.3 million annually.

Alternative B

Alternative B would provide major, long-term benefits to education by expanding the programs under Alternative A to include establishment of a library and resource center for students and teachers, development of biological and historical education media to meet Virginia and North Carolina education standards, establishing refuge-specific teacher training courses, and presentation of educational programs through the development of the US Highway 17 facility. This facility is envisioned as the Great Dismal Swamp Natural Science Center. In addition to refuge staff, it would provide facilities for cooperators, such as The Nature Conservancy, the Great Dismal Swamp Coalition, and other local conservation organizations, and would educate visitors about the entire Great Dismal Swamp ecosystem, which extends far beyond the boundaries of the refuge. The development of such a facility would be expected to have a synergistic effect, combining the resources of conservation organizations to educate the public and local decision makers.

Alternative B would greatly expand other public use opportunities and provide major, beneficial impacts. In addition to hunting opportunities under Alternative A, special opportunities for youth to hunt deer, and a recreational bear hunt would be implemented. Bear hunting opportunities in Chesapeake and Suffolk would increase by 200 hunter days. Hunter densities would be approximately 200 acres per hunter. These hunters would experience a high quality wildlife dependent recreational activity, which is limited in the surrounding area. In addition, we expect many of the hunters would travel from outside the local area, providing additional positive economic impacts. By implementing the bear hunt, we would also contribute to the mission of the NWRS by providing another hunting opportunity. During the bear hunt the entrances used will be closed to other public uses. This impact will be minimal and of short duration, since the hunts would be conducted during a lower use period, and at least one other entrance would be open to accommodate other public uses.

Opportunities for fishing and boating would be expanded by allowing a concessionaire to provide canoe/kayak rentals and to provide interpretive

boat tours on Lake Drummond and tram tours on the Railroad/West/ Interior trail. Public access would be enhanced by paving access routes along Jericho Lane and Washington Ditch and associated parking areas; paving the Railroad/West/Interior Ditch access route to Lake Drummond; and establishing an automobile tour route along Corapeake/ Sherrill/ Cross/Forest Line Ditches in the North Carolina portion of the refuge.

Major public use benefits would result from expanded visibility of the refuge. The establishment of a natural science center would greatly expand tourism and education opportunities associated with the Great Dismal Swamp ecosystem. Additional information on the refuge would be available at other highly visible locations (City Visitor Center in Suffolk, Virginia and at the sub-headquarters and contact facility in Sunbury, North Carolina). The construction of a Great Dismal Swamp Natural Science Center on US Highway 17 would dramatically increase the exposure and visitor use of the refuge. The new facility would be closer to tourists and readily accessible by a major highway. This would be a critical improvement over the current facilities that can only be accessed by a lengthy drive on small rural back roads. The location of the new facility would greatly increase the visibility of the Great Dismal Swamp NWR. The proposed location is on the eastern side of the refuge and, therefore, more accessible to a larger portion of the population. A new trail along the Feeder Ditch, linking the Center and Lake Drummond, would give the first public access by land from the east. The Great Dismal Swamp Natural Science Center would be strategically located on a major highway corridor to improve accessibility for local students and visitors as well as travelers arriving to the Hampton Roads area.

Economic benefits would result from additional license purchases, additional local employment (both staff and concessionaire), and revenues from boat and bicycle rentals, guided tour fees, and retail sales of guide books, posters, etc.

Under Alternative B the refuge would also seek to cooperatively manage the Nansemond NWR with another agency. This cooperative management would likely result in expanded public use opportunities.

Under Alternative B, total visitor use would be expected to exceed 500,000 visitor-days per year. The new complex on US Highway 17 would be expected to attract approximately 400,000 visitors annually, based on current requests for Great Dismal Swamp NWR information from the Dismal Swamp Canal Welcome Center. Visitation on the western side of the refuge would be expected to increase to approximately 100,000 annually based on expanded trails, interpretive sites, and recreation. Increased visitation from development of a visitor

contact station on the southwest corner at the Sunbury sub-headquarters of the refuge would be approximately 13,000 annually. The total annual economic impact would be approximately $8.0 million.

Alternative C

Educational impacts under Alternative C would be identical to Alternative B. Under Alternative C, other public use would be slightly less than that proposed under Alternative B; impacts would be beneficial and moderate. Elimation of the bear hunt would decrease hunting opportunities and the elimination of the Sunbury, North Carolina contact station would provide less opportunity to service visitors approaching from the southwest. The economic impact of Alternative C would be approximately $7.75 million annually.

Cumulative Impacts

Alternative A

Alternative A provides minor benefits to natural resources at Great Dismal Swamp NWR and one major long-term benefit for RCWs. Benefits result from hydrologic regime improvements and restoration of scarce habitats. Direct, negative impacts to natural resources are limited because there are few provisions to expand public use opportunities. Total benefit to the regional economy (including salaries, maintenance, development, and tourism) would be approximately $2.8 million annually.

Alternative B

Alternative B would provide major benefits to many natural resources at Great Dismal Swamp NWR. These include restoration of hydrology, expanding habitat restoration to aggressively restore more than 10 percent of the refuge. These efforts mostly benefit rare habitat types.

Public use and socio-economics would also benefit under Alternative B. Public access would be expanded through increases in interpretive tours, a new hiking trail, observation towers, and recreation and hunting opportunities. Expansion of the educational program would benefit school systems throughout the Hampton Roads area. Economic benefits would result from expanded staff and maintenance budgets needed to implement the changes, and from increased tourism opportunities. Total benefit to the regional economy would be approximately $12.4 million annually.

Alternative C

Alternative C would provide only limited benefits to natural resources, similar to Alternative A, but would still include significant habitat restoration to support RCWs. Benefits to public use and socio-economics would be similar to, but slightly less than benefits under Alternative B. Benefits would be less than Alternative B because the staffing level is less. Total benefit to the regional economy (including salaries, maintenance, development, and tourism) would be approximately $11.7 million annually.

Short -Term Use Versus Long-Term Productivity

Short-term and long-term effects describe the relationship between local short-term uses of the human environment and maintenance of long-term productivity of the environment. All of the alternatives are clearly aimed at enhancing the long-term productivity and sustainability of natural resources on the refuge. To varying degrees, the alternatives propose to implement actions that promote watershed or ecosystem-wide partnerships and additional planning. Outreach and environmental education are a priority to encourage refuge visitors to be better stewards of our environment.

Short-term economic effects would be felt in the immediate impact of land purchases. There would be short-term impacts on tax collections for the year in which a property is acquired. In the long term, however, land protection would reduce local government expenses for infrastructure development of roads, sewers, law enforcement and fire protection, and utilities while providing essential habitat for wildlife and outdoor recreation. Loss of taxes would be partially offset by the annual Refuge Revenue Sharing payments.

In the long run, local economies would be impacted positively by increased spending on environmental programs and visitor services. The programs would attract visitors and positively attract tourism and wildlife-dependent recreation to Hampton Roads. In the long term, most of the adverse effects would be mitigated or offset by positive impact from increased open space and an increase in the quality of life for people as well as wildlife.

General impacts on biological resources are expected to be long-term and beneficial. Habitat for endangered and threatened species, such as the red-cockaded woodpecker, would receive high priority for restoration. Neotropical migratory bird habitat would be protected and restored. The restoration of the rare Atlantic white cedar forests would be emphasized. Resting areas for wintering waterfowl would be monitored and protected. Enhanced interpretation and education about the wildlife resources within the Great Dismal Swamp ecosystem would lead to better public understanding and support for the restoration and protection of natural resources that support people and wildlife.

The development of visitor center facilities, trails, observation platforms and kiosks, and visitor/educational facilities would result in both short-term and long-term physical impacts on soil and vegetation. These impacts would be localized and confined to the immediate construction sites. Increased attention to environmental education and recreation programs would result in more audiences being involved with environmental education and wildlife-dependent recreation, and a more positive land ethic of stewardship throughout the refuge watershed. Moreover, the nature-based tourism opportunities would create economic incentives to conserve key natural resources within the watershed.

Long-term beneficial effects include the increased productivity of threatened and endangered species, waterfowl, neotropical migratory birds, a large black bear population, and a myriad of other species dependent upon refuge habitat. The public would also gain long-term opportunities for wildlife-dependent recreation and education.

Short-term uses of refuge lands include hunting, fishing, management for selected species, wildlife inventories, water quality monitoring, forest regeneration, prescribed burning, and the construction of administration and public use facilities. These activities would be implemented with the primary goal of assuring the sustained productivity of refuge resources.

Unavoidable Adverse Impacts

Unavoidable adverse impacts are projected from the changes in levels of management activities as described in Alternatives B and C relative to the Current Management Alternative (Alternative A).

Construction of visitor facilities and increased visitation would affect local air and water quality and natural vegetation through vehicle

emissions, localized damage to vegetation, and soil compaction. Enhanced visitation would also mean additional disturbances to both resident and migratory wildlife. In a review of the literature, little is available on impacts to forested wildlife species from human visitation. The disturbance from increased visitation will have minor impacts on wildlife populations and plant communities, with less than 1% of the land area of the refuge being accessible to the public.

The addition of bear hunting in Alternative B would force the temporary curtailment of non-hunting visitation in the designated bear hunt areas and would disrupt the daily activities of bears and other wildlife during the hunt.

The expansion of prescribed burning operations in Alternative B would increase the probability that populated areas adjacent to the refuge would be affected by smoke when weather forecasts and fire behavior models fail to accurately predict smoke dispersion.

Atlantic white cedar restoration in Alternative B would force the temporary closure of some areas to general public access to allow heavy equipment and logging trucks to move within these areas. The aesthetic quality of restoration sites would be temporarily degraded during restoration operations that require mechanical clearing and removal of trees.

The acquisition of land within the approved acquisition boundary would remove these areas from the tax base of the cities and counties. This impact, however, would be largely offset by the payments to the cities and counties through refuge revenue sharing.

Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that cannot be reversed. For example, the use of non-renewable resources is irreversible: mineral and fossil fuel consumption are not renewable and therefore not available for future use. An irreversible commitment of resources results when an area is altered in such a way that it cannot be returned to its natural condition for an extended period of time.

Irretrievable commitments of resources occur when a renewable resource is allocated to a given use and cannot be recovered without significant effort.

The cost associated with land acquisition for refuges would be irreversible. Refuge land acquisition removes acreage from private ownership and any potential development benefits associated with it. However, such land, once placed in public ownership under the National Wildlife Refuge System, often provides a new set of wildlife-dependent recreational uses that benefit a much broader group of people. Moreover, refuge ownership protects key natural features within the landscape that enhance the quality of life for people. The concept of "public lands" precludes individual freedom to use those lands according to individual desires. Some traditional uses may change, since public uses on a refuge must be shown to be compatible with the purposes for which the land is acquired. Federal ownership may affect surrounding land-use patterns, local economies, and city/county tax revenues. Generally, these changes are positive: residential homes and property located adjacent to the refuge often increase in value, landscapes are protected, nature-based business ventures develop, and costs to local governments for services decrease.

Management of refuge lands acquired would result in an irreversible and irretrievable commitment of funding for operations, administration, and management. Funding and personnel commitments by the Service to purchasing and managing refuge lands and facilities render those resources unavailable for other Service programs and projects. The more public use activities and facilities provided, the greater operating and maintenance cost involved.

Some irreversible loss of potential wildlife habitat would occur at construction sites for new facilities. However, most of the new construction is proposed on land that is not currently within the refuge, so the effects on existing refuge habitat would be minimal. Moreover, these irreversible impacts of visitor use facilities and improvements would be mitigated somewhat by their function in confining the major impacts of visitors to a relatively few selected areas.

Animal and plant communities are renewable in different degrees. Construction sites, and some habitat management practices, may irretrievably damage natural communities, at least for a period of time. Wildlife taken through hunting, fishing, or nuisance control would no longer be available for wildlife observation and photography. These activities, however, would be managed in such a way that the health and viability of wildlife populations would not be threatened.